Modifications of Winter Hydrology Subroutines in WEPP

(Shuhui Dun and Joan Wu, July 1, 2008)

(1) Solar radiation on sloped surface

Diffusive radiation is now also considered.

(2) Cloud cover

We now use solar radiation under clear sky, instead of extraterrestrial solar radiation, as the maximum solar radiation that can reach a horizontal surface, in estimating cloud cover.

(3) Start time of storm events

When using break-point climate input data, we use the input value, instead of a randomly generated time, for the start time of a rainfall event.

(4) Snow accumulation

We have corrected a problem in snow consolidation. The previous version WEPP 2006.5 tends to underestimate snow density and overestimate snow depth when a precipitation event last several days because snow-pack settling was not estimated during a precipitation event and when there is no snowmelt. We have also corrected the problem with rain on a snow pack so that rain will not infiltrate or run off before the liquid-water-retaining capacity of the snow is reached.

(5) Snowmelt

The following problems have been corrected: (i) dew-point temperature was originally estimated following a sine function during a day and is now taken directly from the weather input; (ii) the coding of the equation for adjusting wind velocity was incorrect, and we now apply a simpler equation from the ACE; and (iii) we have incorporated the ACE's convection-condensation equation for heavily forested areas into the snowmelt routines of WEPP.

(6) Frost simulation

   i.   More, finer soil layers (10 layers in each original soil layer), instead of only two layers (tilled and untilled), are used in frost simulation.
   ii. The problem of mixed use of energy flux and energy amount is corrected.
   iii. In the present version, soil temperature one meter below the frozen zone is estimated following an annual air-temperature curve, instead of the assumption that this temperature is always 7 °C.
   iv. Unsaturated hydraulic conductivity and soil water potential in the winter routines are now estimated following Saxton and Rawls (2006) instead of the method of P. Kalita.
   v.   Saturated hydraulic conductivity of frozen soil is taken as the unsaturated hydraulic conductivity at a soil water content of porosity minus ice content.
   vi. A subroutine has been added to compute soil water redistribution when frost is present.